Journal of Mechanical and Mechanics Engineering
Volume 3 Issue 2

CVT:INNOVATION GET GOING

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Abstract

As we all know our automobile industry is expanding day by day and is working continuously in increasing the efficiency of fuel economy. With limited room for improvement, automobile manufacturers have begun full scale development of alternative power vehicles. Still the manufacturers are not going with those alternate options, knowing the market of IC engines and related infrastructure, and also, it's not feasible to scrap the IC engine tech with a "success not sure" option. Thus, the only option which is left is the set of attempts, to increase the efficiency of concurrent IC engines. One potential solution is the Continuously Variable Transmission (CVT. This old idea has become a boon in disguise for automarkers. The idea of CVT was conceptualized by Leornado da Vinci.

Keywords: *CVT, Transmission, Torque, Gear, Hydraulic Actuator, Pulleys.*

INTRODUCTION

A transmission that can change seamlessly through a continuous range of gear ratios is what a CVT is all about. The flexibility factor of CVT allows the input shaft in maintaining a constant angular velocity. Literally, there is no requirement of clutch in CVT, still some vehicles make use of a centrifugal clutch to facilitate a "neutral stance", helpful while idling or reversing into a parking lot.

A.BACKGROUND

The fundamental purpose of a transmission is the translation of engine performance into vehicle performance. This purpose is accomplished by providing a variety of gear ratios between the engine crankshaft and the output axle of the vehicle. Different speed profile and torque is attained at each gear ratio, while the engine operates at the same speed. Transmission aims at allowing the engine to operate within an ideal state of power production, and also, apply this power to the track by using appropriate gear ratio. Conventional transmission increases vehicle speed, simultaneously maintaining the engine operating range through the use of gear sets. The power that is transmitted from the engine crankshaft is converted into a usable power at the output shaft with the aid of a clutching mechanism. This mechanism engages specific gears that depend primarily on the vehicle speed. It is seen that with increase in gear ratio, the speed/angular velocity of the output axle increases. This increase is in relation to the angular velocity of the engine crankshaft.

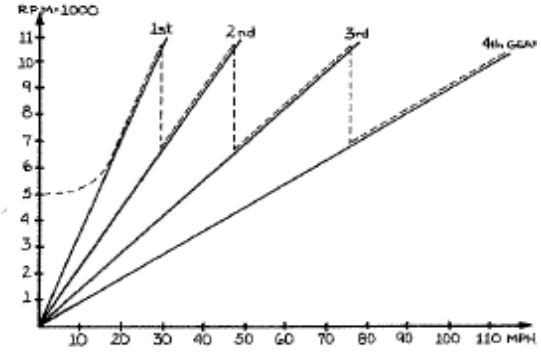


Fig 1:*Relation between Revolutions per Minute and Speed (Miles per hour)* ***[Dashed***

line represents the rise and fall of engine speed as each gear change is made.]

Conventional 4-speed transmission experience a rise and fall in engine speed between 6000 and 11000 RPM, as gear exchange occurs and the speed of vehicle witness an increment. For an orthodox transmission, speeds fluctuation at each gear exchange is used to facilitate the fluid gear transfer. As the gears being exchanged and noticeable increment in speed, the slope of the engine speed and vehicle speed at each gear is distinct. Each gear and respective slope depicts a different ratio of gain in engine speed. Hence, because of this change in slope, each gear is made useful by producing a distinct range of vehicle speed and torque production. Steeper slopes, as in case of first gear, represent high torque situations in which there is a lower gear ratio and the output axle rotates slowly in comparison of the engine crankshaft. A counteracting torque produced by the same engine power, do counteract the vehicle inertia and also, vehicle accelerate quickly up to a certain specified speed. As soon the higher gears are achieved, it becomes difficult for the same engine power to propel the vehicle; hence the rate of vehicle acceleration and the application of the torque decreases, but the overall speed rise as the output axle rotate as quickly as the crankshaft does. CVT is a low weight gear reduction system that utilizes a little regulatory mechanism to achieve the same point, as an orthodox automatic transmission do achieves.

B. STRUCTURE OF CVT

CVT makes use of two pulleys, along with a steel belt running between them. To facilitate the variation of the gear ratios, the CVT adjusts the diameter of the "driver pulley", which transmits torque from the engine and "driven pulley" that transfers this torque to the wheels. Because of it being continuously variable, the CVT not only avoids the shift-shock and peaks and dips in the torque transmission associated with a conventional AT, but also does maintain the optimum torque for any power demand. This all makes CVT an exceptional transmission solution that delivers smooth and powerful driving experience, coupled with an excellent fuel economy.

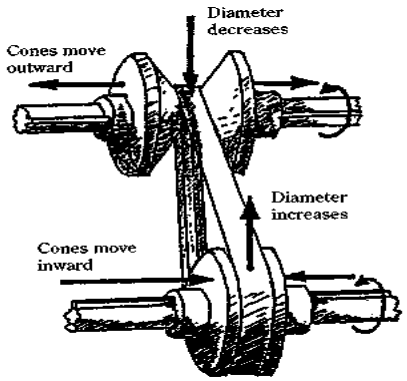
C. COMPONENTSOF CVT

1. A high power/density belt.
2. A set of Cone pulleys.
3. Hydraulic Actuator.
4. Mechanical torque sensor.
5. Microprocessor.
6. Torque Converter or Multi-layered clutch (replacing conventionalclutches).

D. WORKING PRINCIPLE OF CVT

A CVT operates by varying the diameter of the two main pulleys working in the transmission. The pulleys got V-shaped grooves on which a connecting belt is mounted. One side of the pulley is kept fixed while the other side is movable, operated with a hydraulic actuator. The hydraulic actuator can increase or decrease the spacing between the sides of the pulley. This makes the belt to ride higher or lower along the inner walls of the pulley, dependent on the driving conditions, thereby changing the gear ratio accordingly. With no steps in between, this action is purely infinitely variable. That's

why; a CVT helps the engine to be in its optimum range of RPM, which boosts the overall efficiency and mileage. Oil pressure in the actuator that responds to the position of the throttle, speed and related conditions, adjusts the pulley widths. It is sensed by the microprocessors and other sensors incorporated in the system. **(Figure 2:-** Working principle of the CVT**)**



E. NISSAN'S 3RD GENERATION XTRONIC CVT

To achieve high measures of both fuel economy and acceleration was the basic approach of Nissan to power trains.

F. WIDER GEAR RATIO RANGE

XTRONIC CVT has the gear ratio ranges from low to high gear. Being expanded, it attains a best-in-class gear reduction ratio of about 6. All credit goes to the pulley and steel belt modifications and use of high end performer, the Automatic Transmission Fluid. It finds its use in CVT designed for use in 1.5L to 2.0 L engines. The low end of range is extended to improve the fuel economy. Also, Nissan CVT is flexibly tunable to match engine characteristics, thereby enables optimization of the balance between combustion efficiency and acceleration.

G. WIDE LOCKUP RANGE

Lockup of AT torque convertor enables MT-like direct transfer of engine power, also an improvement in fuel economy. A conventional AT locks up in the mid-to-high speed range, the advantage of a torque convertor in a CVT is only during the time of initial startup. Therefore, the all new XTRONIC CVT has applied precise control of ratio changes to extend this lock up operating area even further into the low speed range, boosting the fuel economy.

H. EFFICIENCY IMPROVEMENTS

There is a slight modification in the size of oil pump. This is the main source of the hydraulic power that is used for shifting and to assure the proper torque transmission. It has been downsized, which in turn made it way more efficient. This helps in maintaining control stability that follows, closely, the accelerator pedal action, while boosting fuel economy. A compact chain drive, contributing to the downsizing of the transmission system as a whole, has been adopted in NISSAN's 2.0L class CVT.

I. CVT MODIFICATIN FOR HEV APPLICATION

NISSAN CK-2 CVT was modified. It used a Van Doorne Push-belt type, commercially available in several Japanese production vehicles. Many modifications, mechanical and electrical, were made, both internal and external to the transmission. In the stock trim, there's an off-board transmission control unit that controls the torque convertor lock up, CVT ratio, and the hydraulic pressure that accompanies the CVT. In its original design, the mechanical hydraulic pump is connected to the engine through the torque converter.

J. ADVANTAGES OF CVT

1. Comparatively better fuel consumption than a regular AT, because of the ability of CVT to keep the vehicle in its optimum power range, being regardless of the speed
2. Due to low power loss experienced, an improved acceleration.
3. An infinitely variable step less transmission.

4. Adapts very easily with the varying road conditions and power demands, to allow better driving experience.
5. Improvement in Emission control, and also there are low greenhouse emissions because of improved control of engine speed range.

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